Volume 28 October, 1942 *Number 10*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Industrial Coal Burning Equipment

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS

for

BOILER PLANT STOKERS

GENERAL LUBRICATION

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FOR CRANKCASE OF STOKER ENGINES OF THE DOUBLE-ACTING TYPE	Texaco Regal Oils
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FOR WORM AND SPUR GEAR DRIVES *(Operating Exposed)*	Texaco Crater No. 0 or No. 1
FOR SILENT CHAIN DRIVES *(Chains Submerged and Bath Lubricated)*	Texaco Altair Oil or Aries Oil
*CHAINS ENCLOSED BUT NOT SUBMERGED IN OIL *(or Where Chains are Exposed)*	Texaco Thuban 140 or Texaco Crater No. 0
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FOR SATURATED STEAM: *BELOW 150 LBS. PRESSURE Where Conditions of Feed are Good*	Texaco Pinnacle Cylinder Oil
WHERE ATOMIZATION CONDITIONS ARE POOR OR RAPID SEPARATION FROM EXHAUST STEAM IS NECESSARY	Texaco Vanguard Cylinder Oil or Texaco Olympian Cylinder Oil
WHERE CONDENSED STEAM IS TO BE RETURNED TO BOILER, USED FOR THE MANUFACTURE OF ICE, OR IN OTHER PROCESS WORK	Texaco Vanguard Cylinder Oil Texaco Vanguard Mineral Cylinder Oil Texaco Pinnacle Mineral Cylinder Oil or Texaco 650 T Mineral Cylinder Oil
WHERE RAPID ATOMIZATION IS NECESSARY, MEDIUM STEAM PRESSURES AND MOISTURE CONDITIONS INVOLVED, AND OIL FEEDS ARE CLOSE TO STEAM CHEST, ETC.	Texaco Olympian Cylinder Oil
FOR LOW PRESSURE WET STEAM CONDITIONS	Texaco Draco Cylinder Oil

Use cylinder oils carried in the plant if Texaco Thubans are not stocked.

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A Technical Publication Devoted to the Selection and Use of Lubricants

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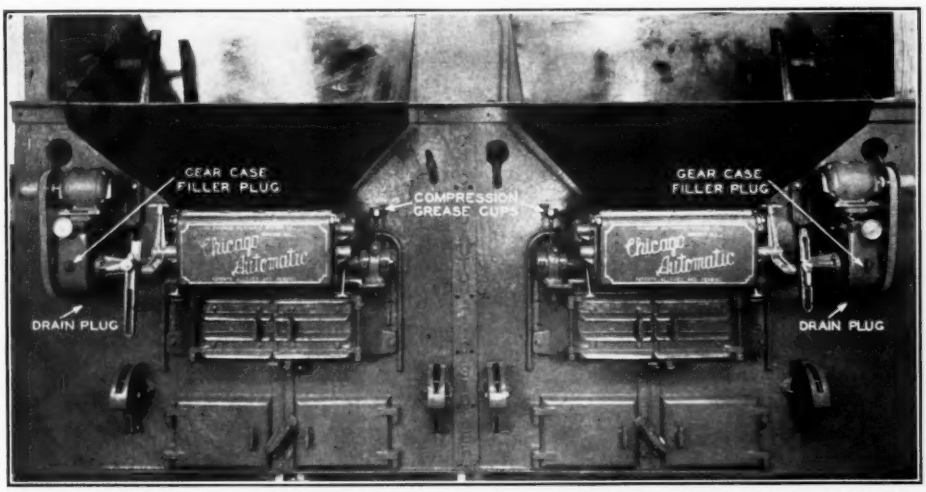
Lubrication of Industrial Coal Burning Equipment

BURNING of coal involved a penalty in England during the sixteenth century. Today it penalizes our pocket-books if we do not burn it—correctly. It seems almost mythical that this valuable fuel should have been so regarded by the Court of King Henry VIII, but the reason is obvious—smoke added to the traditional fogs of London, and along with negligible means for street lighting at night it promoted the original "black-out."

Since those "unlightened" times we have learned a lot about coal. No longer does industry or the householder lose the better part of the heat value up the stack. Nor do clouds of smoke indicate a hive of industry. The marine engineer coined a term which is significant, "a feather of smoke." When we see that, it denotes efficient combustion and maximum utilization of the B.T.U.'s available. We will need a lot of these this winter in the presence of the unparalleled demands on our other types of fuel.



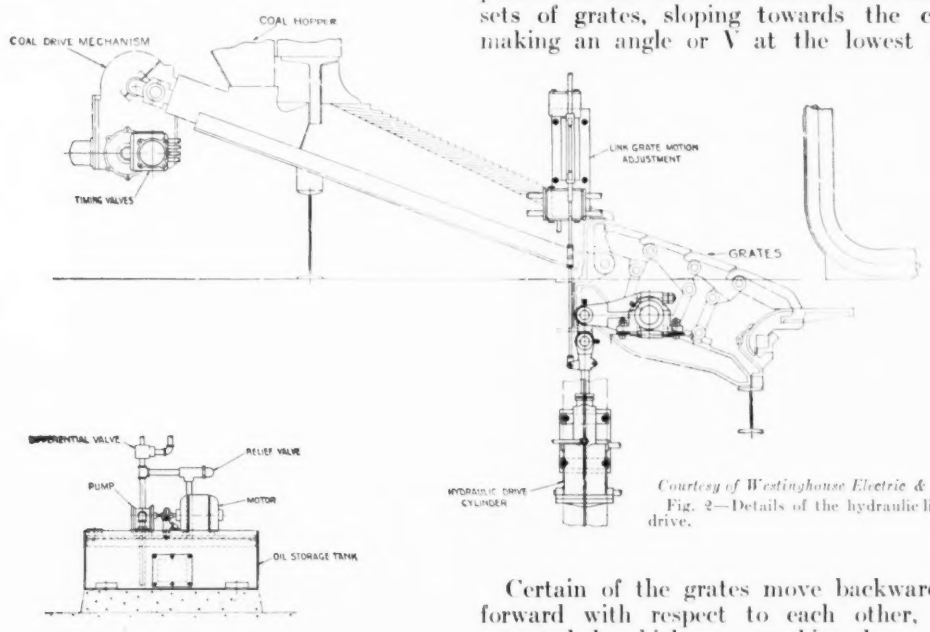
Courtesy of Chicago Automatic Stoker Co.

Fig. 1—Front view of a Chicago Automatic Stoker showing points of lubrication.

Coal burning is a process of oxidation. In other words, some fifteen pounds of air are required for efficient combustion of one pound of coal. It was impracticable to attain this

objective by hand firing, so the stoker and pulverizer were perfected. In other words, automatic firing of coal decreases the cost of handling and stoking and increases the rate of evaporation, or steam or heat generating efficiency. From an economic point of view the ultimate result should be a decrease in fuel consumption which should react favorably whenever coal handling or storage facilities must be studied.

Lubrication is most important in the development of efficient stoker or pulverizer operation. Under overload conditions it must be given especially careful consideration, for a lubrication schedule suitable for normal operation may be entirely inadequate if the mechanisms are to be speeded up and run in continuous 24-hour service. In appreciation of this fact some builders of heavy duty equipment have already established so-called emergency lubrication schedules to the end that re-lubrication should be done two or three times more often than would be necessary under normal conditions.



Courtesy of Westinghouse Electric & Mfg. Co.
Fig. 2—Details of the hydraulic link grate drive.

STOKER DESIGN

Mechanical stokers are known as:
(a) the overfeed
(b) the underfeed or
(c) the traveling or chain grate type.

The mechanism of the modern stoker is relatively simple in design, the driving unit being the essential part requiring lubrication. Individual manufacturers, however, employ various adaptations or types of drives according to the operating requirements. Lubrication will be contingent upon gear and bearing construction and the means provided for applying the lubricants.

The Overfeed Type

Coal is fed by the overfeed stoker at the sides or at the front end of the furnace through a hopper or magazine, being distributed along the top of an inclined set of grates. Where front feed is involved the grates slope towards the rear of the furnace, being set in one uniform plane. In the side feed furnace there are two sets of grates, sloping towards the center, making an angle or V at the lowest point.

Certain of the grates move backward and forward with respect to each other, being actuated by kicker or rocking bars. This motion carries the coal down the grates to the rear or center. All this time combustion is taking place, coking and the burning of volatile gases occurring while the coal is on the upper parts of the grate.

Underfeed Stokers

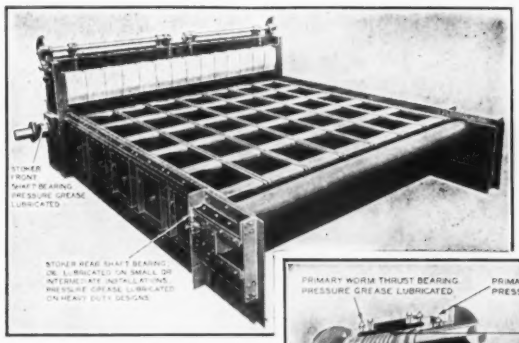
Underfeed stokers of the industrial type provide for the introduction of fresh coal beneath the fuel bed by means of steam or electric driven rams or plungers. The coal is usually delivered through a gravity feed hopper to the several retorts in which these rams or plungers operate. Essentially these retorts are individual primary combustion chambers, the sides being either stationary or subject to reciprocating motion.

Chain and Traveling Grate Stokers

The Chain grate stoker involves an endless chain which passes over suitable sprockets at the front and rear of the furnace, the meshed

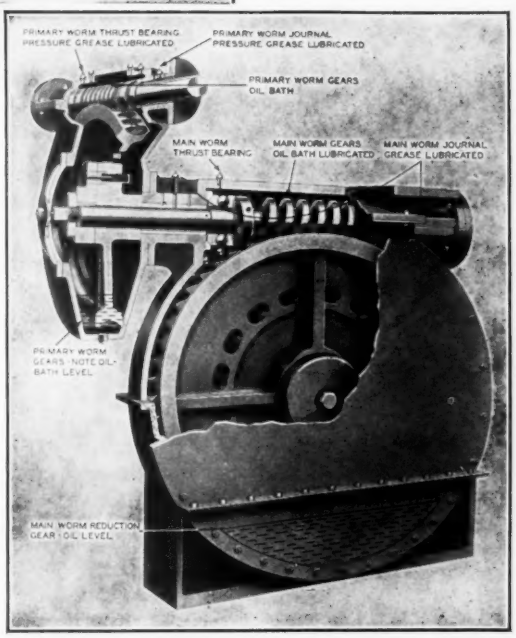
links or bars of this chain serving as the grate for the fuel bed. The grate surface of the traveling stoker is composed of overlapping sections carried on transverse bars.

The necessary sprockets are fastened to suitable shafts which are part of the base frame of the stoker. Either the front or rear sprocket can be used as the driving element by suitable connection to a worm reduction gear mechanism, which in turn may be driven by steam or electric power.



Courtesy of The Babcock & Wilcox Co.

Fig. 3—Lubrication details for the drive and chain grate mechanism of a B & W chain-grate stoker.



The Operating Mechanisms

Some form of reduction geared power unit is used to manipulate the grates of the overfeed stoker, operate the plungers, rams or worm of the underfeed machine, run the chain grate at the desired speed, and turn the clinker grinder. This may be a small reciprocating steam engine, a turbine or an electric motor; the latter predominates today.

In the overfeed stoker the feature of operation is the rocking or reciprocating motion to which the grates are subjected. This is brought about by means of a kicker bar or rocker which receives its reciprocating motion from the driving unit through a crank, eccentric connection, or a series of toggle levers.

The plungers and distributing rams are usually connected to the driving unit through a suitable crank shaft of heavy construction. The driving unit also can be further connected through crank, link or rod mechanisms to operate a clinker grinder if necessary, and perhaps the reciprocating overfeed grates and retort side bars.

The principal operating part in the chain grate stoker is the driving unit. This may be attached to either the front or rear sprocket shaft through suitable reduction gearing. Additional mitre gears in connection with adjustable ratchet mechanisms are also used on some front feed stoker drives for the purpose of regulating the coal feeding device. In other types of such stokers a hand wheel operated worm and gear device is used for the controlling of the coal feed from the hopper onto the stoker chain. The sprocket shafts are carried in pedestal bearings of suitable size and construction to meet the wearing conditions and enable the requisite lubrication.

PULVERIZER CONTRUCTION AND OPERATION

The pulverizer consists of a horizontal or vertical rotating pulverizing element mounted on a shaft, the whole being contained within a suitable housing. According to the design, the pulverizing element or rotor may be constructed to perform its intended function in one or more stages, air being provided to carry the coal through the system, and aid in bringing about combustion.

Actual breaking up or pulverization of the coal is accomplished by swing hammers, rings, tubes, balls or suitable rolls in conjunction with the crushing surface. This action develops a load condition which may be severe. In addition, coal dust is continually present, sulfur products which will tend to react with water to form corrosive acids may have to be handled, and dampness frequently prevails. All of these may affect lubrication adversely, causing scoring or corrosion of the rotor bearings, or the contact elements in other equipment.

Features of Design

With the unit type of machine we are primarily concerned with lubrication of the bearings of pulverizers, motors, air fans and conveyors, and the essential driving gears.

Ball and roller bearings are extensively used to carry the main shafting of rotary pulverizers,

also the fan elements. Sealed housings will effectively protect these parts against the entry of abrasive coal dust, dampness or perhaps metallic particles. This is naturally of extreme importance as an adjunct to lubrication.

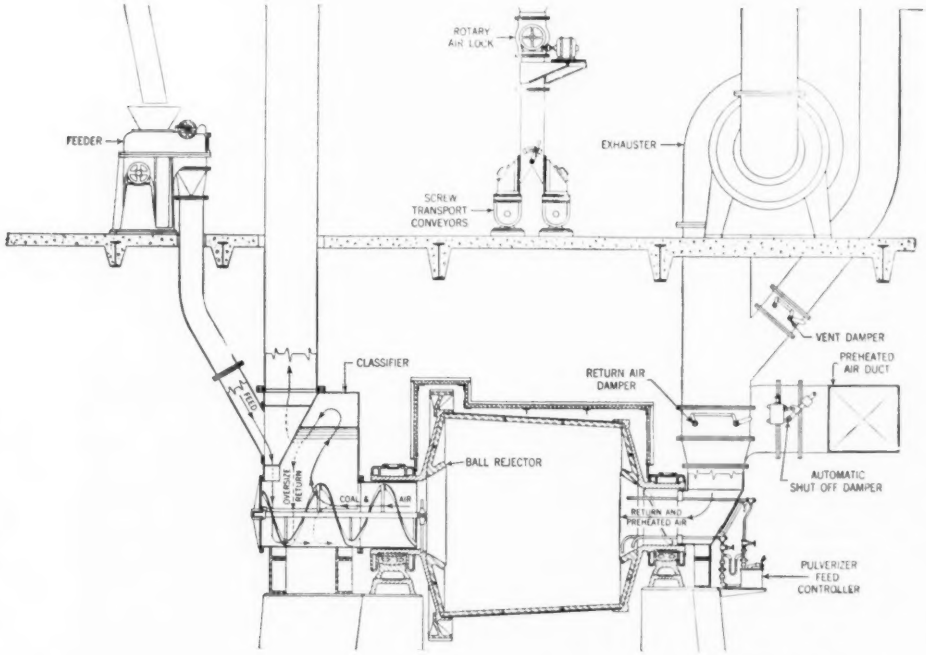
Ring-Oiled Bearings

A ring-oiled bearing provides for the continual delivery of oil to the bearing surfaces by means of a ring which is suspended from the shaft. This ring dips into the oil which is contained in the reservoir. This latter must be of adequate capacity to give the oil ample opportunity to rest, thereby making possible not only the settling out of sediment and other foreign matter, but also cooling to the requisite degree. As a rule the only way in which the oil in such a system is kept at the proper temperature is by radiation of heat from the exterior surfaces of the reservoir.

The oil which is carried to the top of a ring-oiled bearing must be taken care of and returned to the reservoir as rapidly as it is delivered by the ring; otherwise oil will tend to accumulate in the upper part of the housing to ultimately be forced out through the ends of the bearings. The same condition may arise if the oil is carried too high in the well, or if the ring rotates at too high a speed. This will cause splashing and churning of the oil.

Ball and Roller Bearings

Ball and roller bearings have proven extremely adaptable where requirements such as reduction in attention and positiveness of action are required. Ball bearings can be lubricated either with oil or grease according to the design of the bearing housings. Roller bearings can be similarly lubricated though the type and construction of the rollers also require consideration. The customary housing design affords ideal protection against the entry of contaminating foreign matter.



Courtesy of Foster Wheeler Corporation

Fig. 4—Typical arrangement of the Foster Wheeler system for firing pulverized coal.

Driving Gears

Design dictates the extent to which driving gears are used in the modern pulverizer. On certain types of units, spur or bevelled gears are an essential as a means of bringing about the necessary speed reductions. Others may have the coal pulverizing elements directly connected to the driving motor.

Speed reduction gears are enclosed wherever possible in order to protect the teeth from the abrasive action of foreign matter, and also to insure that more effective and economical lubrication can be maintained. In mills of the vertical type, the driving gears are contained in a housing or case at the base of the machine, the gear shaft being carried in a step or thrust bearing which is very frequently

lubricated by oil from the gear case. It is not always practicable, however, to enclose the driving gears, especially where these are of the girth type, with the main gear completely surrounding the pulverizing element.

heavier lubricant, say within the SAE 250 range.

For the lubrication of exposed gears, it is of course essential to use a product which will stick tenaciously to the teeth and not throw

TROUBLE CHART FOR STOKER AND PULVERIZER LUBRICATION

Mechanism	*Indication of Trouble*	*Correction*
Bearings Plain or Sleeve Type	Overheating	Check alignment, source and amount of lubricant used.
	Accumulation of coal dust Clogged oil returns Sticking oil rings	Drain and flush reservoir and lines. Check dust seals.
	Oil leakage due to excessive splash	Lower the oil level—check regularly—add make-up oil regularly as needed.
Ball or Roller Type	Overheating	Check alignment; see correct amount of lubricant is used.
	Accumulations of coal dust	Clean the bearings and relubricate. When recharging, fill the bearing only about one-third full of grease. Check seals—replace if faulty.
	Undue noise,—a sign of a dry, worn or broken bearing	
	Grease leakage, indicating imperfect sealing Caked or gummy lubricant, indicating breakdown or oxidation	Use a ball or roller bearing grease which has been specially prepared to resist leakage.
Gears All Types	Oil foaming or oil throw, indicating too high an oil level in the case	Reduce the oil level to proper point.
	Noisy gear teeth	Check level regularly—use a heavier or more adhesive lubricant.
	Scuffed gear teeth	Drain, clean and refill the gear case with suitable gear lubricant.
	Dry tooth surfaces	Apply lubricant more frequently to exposed gears or use a heavier lubricant.
Chains Silent, Belt or Roller Type	Uneven wear of links	Check for alignment.
	Excessive wear	Flush and clean chains and casings regularly—remove and wash exposed chains regularly according to builders recommendations.
	Failure of, or diminished oil supply	Check oil lines and oil level in chain casing. Clean lines if clogged.
	Noisy operation Dry links	Apply lubricant more frequently to exposed chains.

Manner of Lubrication

Where driving gears are properly housed in an oiltight casing, lubrication is maintained by carrying the oil level in the case at a proper height. Frequently, this is fixed by the installation of an overflow device. The lubricant, in turn, should be of the nature of a straight mineral steam cylinder oil having a viscosity of from 100 to 200 seconds Saybolt Universal at 210 degrees Fahr. There may be some instances, however, where operating temperatures will be comparatively high, or where heavy duty is involved, in which case it would be advisable to substitute a somewhat

off or ball up if contaminated by powdered coal, or other dust which may prevail around the plant. As a rule, such gears are lubricated with a product ranging from 500 to 1000 seconds Saybolt Universal at 210 degrees Fahr.

LUBRICATION REQUIREMENTS

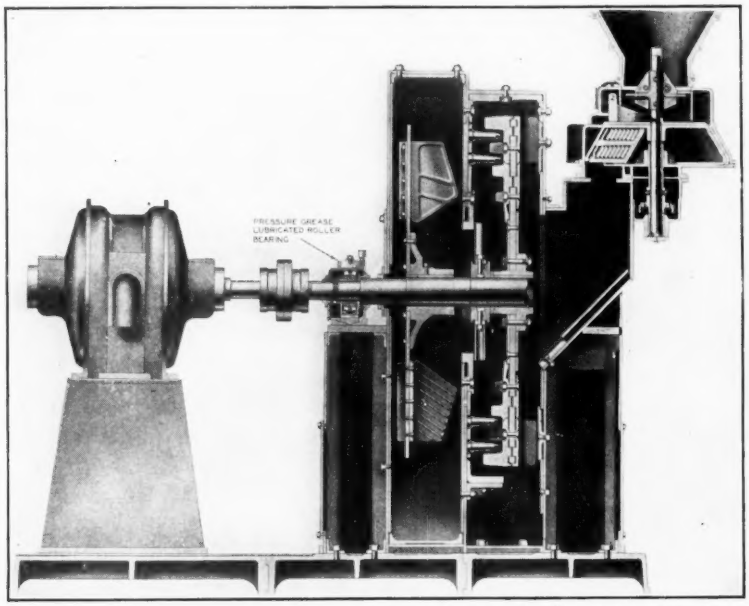
In the lubrication of any mechanical stoker drive, or the bearing elements of a coal pulverizer, it is important to understand the lubricating requirements as dictated by the operating conditions. This requires investigation of the temperatures and pressures which may prevail, and the possibility of contamination of lubricants by abrasive foreign matter.

In the Pulverizer

Lubrication on such equipment performs a dual function in that:

(a) It must reduce metallic or solid friction to a minimum by the maintenance of a film of fluid oil between the bearing surfaces or other surfaces in motion with respect to one another; and

(b) Protect these surfaces from scoring or abrasion, by preventing entry of foreign matter such as coal dust.



Courtesy of Riley Stoker Corporation

Fig. 5—The Riley Atrita unit pulverizer. The motor and guide bearings are the only parts requiring lubrication.

Friction, or the braking element which determines the amount of power required to operate any part of a machine, is reduced by substituting the fluid friction of oil for the solid friction which would otherwise occur between any two solid surfaces in motion with respect to each other. Fluid friction is far lower than solid friction, therefore, continued operation at high speeds is possible, provided that this film of oil is maintained in unbroken condition by proper application of fresh lubricant. Temperatures also are kept within safe limits during operation since the lubricating film acts also as a bearing coolant.

In turn, by selecting lubricants of such body or viscosity as to remain in bearing clearance spaces or upon the surfaces of gear teeth for a reasonable length of time, not only will economy of lubrication be attained, but also entry of foreign abrasive matter via any exposed bearing ends will be prevented.

Inasmuch as lubrication plays so important a part in the attainment of economical operation of automatic coal handling equipment, a detailed discussion of bearings and their constructional details is advisable. Unless we have a knowledge of the lubricating requirements of various types of bearings, it would be a difficult matter to determine correctly the proper grade of oil or grease to use.

In addition, the types of lubricating systems must also be understood. Both oil and grease in their proper consistencies are ideal lubricants; they must, however, be adapted to the systems of lubrication and the construction of the bearings. Either one would give satisfactory service; in some cases, however, unsealed bearing construction, the prevalence of temperature fluctuations or clearances or seals which would permit leakage might markedly influence the resultant performance of the lubricant.

Take the ball or roller bearing for example. Here the purpose of lubrication is to facilitate as easy rolling as possible. To enable this, however, all the surfaces (which are of a highly polished nature) must be in as perfect condition as practicable. The lubricant must therefore serve the dual purpose of both lubricating, and protecting these surfaces against rusting, corrosion, pitting or abnormal wear. Minimum clearance, of course, is an aid to proper functioning of such bearings, for the occurrence of any play between the component parts would tend to set up a certain amount of motion which would be detrimental to effective operation.

Stoker Drives

The mechanical stoker in turn will require consideration of lubrication of its speed reduction gears, the miscellaneous bearings of the accessory connections which serve to operate the movable grates, etc., the pedestal and other more important bearings of both chain grates and underfeed stokers and the driving engines, turbines or electric motors.

In general, these elements and their lubrication can be regarded from four broad viewpoints, dependent upon the type of wearing parts involved, viz.:

1. Reduction gears,

2. Chain drives,
3. Bearings, and
4. Steam cylinders.

While many of the moving parts of any type of mechanical stoker are exposed to a certain amount of heat, those parts which require lubrication are generally subject to average boiler room temperatures. These latter, however, may often be sufficiently abnormal to render lubrication a serious problem. Bearings of movable grate connections as a rule will be chiefly affected in this respect. Other operating parts being outside the furnace are subject only to the heat radiated from the boiler.

TYPES OF LUBRICANTS

The type of lubricant which will be best adapted to any specific wearing part of the average stoker or pulverizer, will be dictated by the design and the means provided for lubrication.

Ring Oiling Requirements

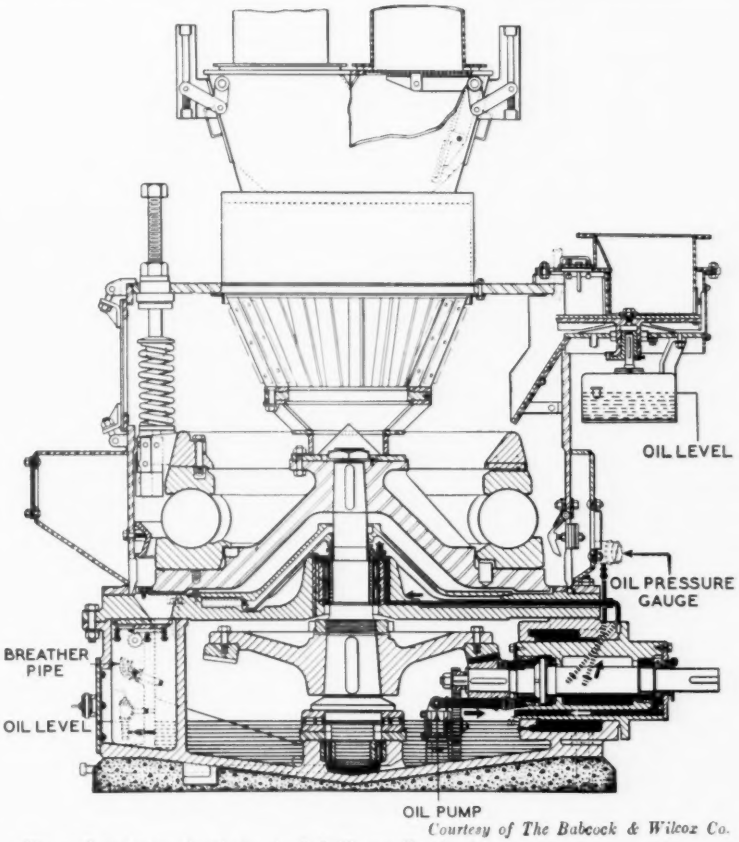
Lubrication of ring oilers at normal operating temperatures (up to around 125 degrees Fahr.), can be satisfactorily maintained by use of a high grade straight mineral oil of approximately 150 to 200 seconds Saybolt Universal at 100 degrees Fahr. In determining upon the viscosity of such an oil, the bearing construction should be investigated; oftentimes if oil returns are too small they may become clogged, causing heavier oils to overflow.

By virtue of the fact that certain equipment may frequently be called upon to function under abnormally low temperatures, an oil of ample fluidity at these temperatures should be chosen wherever possible. Normally an oil of around zero degrees Fahr. pour test will function satisfactorily.

On the other hand, higher temperatures will oftentimes require additional viscosity to resist the thinning down action of heat. For a temperature range of from 125 to 160 degrees Fahr., an oil of from 300 to 500 seconds viscosity may be advisable. For operating temperatures above 160 degrees, straight mineral steam cylinder oils should be considered.

Ball Bearing Lubricants

As light a lubricant should be used in a ball bearing as can be successfully retained in the bearing housing, commensurate with the temperatures and pressures involved. Usually an oil with a viscosity of from 100 to 200 seconds Saybolt Universal at 100 degrees Fahr., will be best.



Courtesy of The Babcock & Wilcox Co.

Fig. 6—Lubrication details for the B & W type E pulverizer.

To reduce the possibility of the development of abnormal internal friction within the lubricant, it is generally advisable to pay careful attention to the oil level. Submergence of approximately one-half to three-quarters of the lowest ball will normally be sufficient. In this connection it is important to remember that contrary to the principles of plain bearing lubrication, the oil in a ball or roller bearing plays a negligible part as a coolant. Therefore, volume is a detriment rather than an advantage.

Roller Bearings

Roller bearing lubrication by means of oil is subject to much the same conditions as with ball bearings. Where end thrust may develop

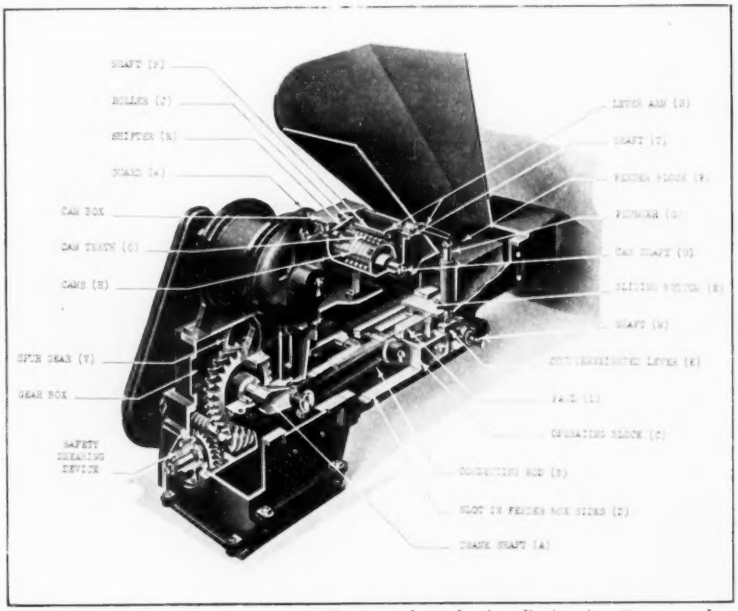
to an appreciable extent, however, due to difficulty in keeping the rollers in alignment, or where pressures or temperatures may be high, a heavier oil may be advisable. Under such conditions a straight mineral lubricating oil of as high as 750 seconds Saybolt Universal viscosity at 100 degrees Fahr. may be necessary. Straight mineral cylinder oils of a high degree of purity may even be required under conditions of extremely high duty, pressure or temperature.

The selection of heavier oils for roller bearing lubrication, however, should be carried out with the utmost care for it is very possible to over-estimate the conditions of operation, with the result that an excess of internal friction may be developed. As a rule, careful observation of operating temperatures, and cooperation with the bearing manufacturers and the petroleum industry as to the proper grade of lubricant for any such condition is advocated.

thinning-out effects of heat, and prevent the consequent entry of dust, dirt, or other contaminating foreign matter.

Steam Cylinders

Stoker engine cylinders normally are lubri-



Courtesy of Combustion Engineering Company, Inc.

Fig. 7—Details of the Combustion Engineering type E stoker. Note gear drive mechanism and relation to bearings.

Where Grease is Advisable

Wherever there is possibility of oil leakage, or under conditions of dust, dirt or dampness, abnormal pressure or high temperature, it may be advisable to use grease as the lubricant for a ball or roller bearing. Greases furnish better seals against the entry of dust, dirt and moisture, thereby serving to protect the polished surfaces of the bearing elements in a very satisfactory manner. Grease also can be very much more effectively retained in a non-oil-tight housing; on the other hand, dirt or grit that finds its way into a grease-lubricated bearing, has no means of settling out, but is frequently held in suspension, being carried back into the bearing repeatedly.

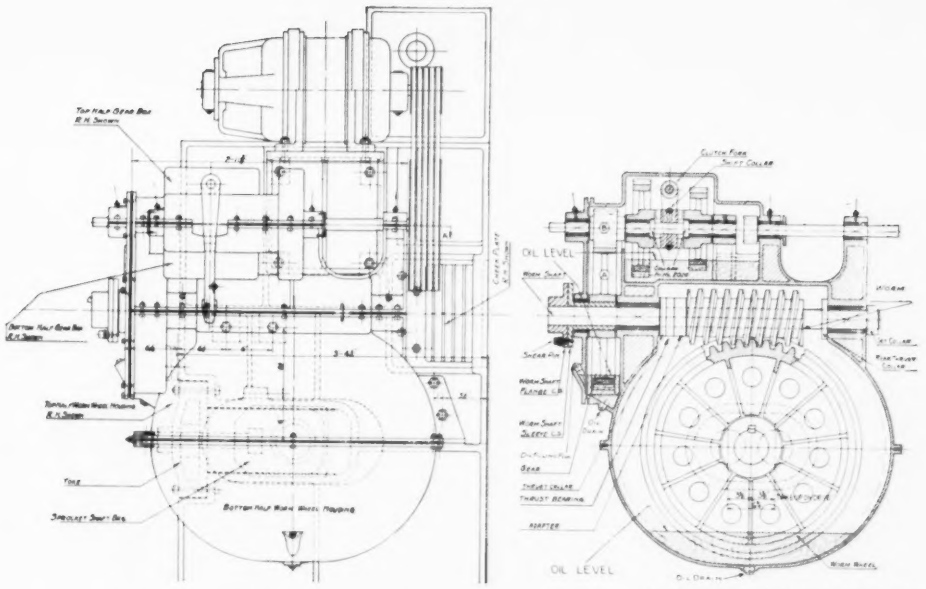
As a general rule, products of comparatively light consistency will meet average operating conditions where the lubricant must readily cover the entire surfaces of the rolling elements and not tend to channel in the housing or raceways, as might occur with more viscous products of this nature which would have less of a penetrative ability.

Under conditions of abnormally high temperature, it might be necessary to resort to greases of greater body to withstand the

cated by the steam cylinder oil used elsewhere in the plant. If they present the only reciprocating steam units, a medium viscosity, highly adhesive, steam refined cylinder oil should be used. If this oil contains a sufficient amount of high grade animal or fixed oil to promote the formation of a tenacious film of emulsified lubricant, it will resist the washing action of any water that may be present.

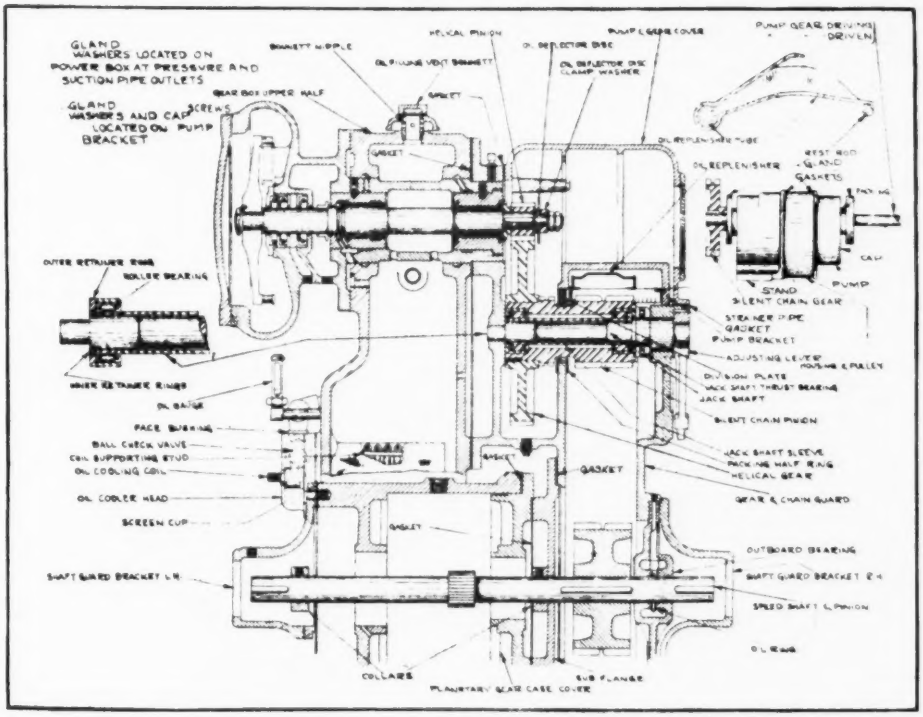
Viscosity or body is attainable by suitable refining; adhesiveness by adding certain fixed or fatty animal oils. As a general rule, it will be essential to use an oil having a viscosity range of between approximately 100 and 160 seconds Saybolt at 210 degrees Fahr., according to the steam pressure and temperature involved, the type of steam valves and the means of application. The latter, in turn, requires study of the construction of the atomizer and the type of lubricator.

A suitable atomizer installed in the steam line affords a most efficient way of getting the lubricating oil to all desired points inside of the valve chambers and cylinders by using the steam as a carrier. By dividing the oil into minute globules and intimately mixing it with the steam, only a very small quantity is required.



Courtesy of Laclede Stoker Company

Fig. 8—Assembly of drive for Laclede forced draft stokers showing oil level for each gear case.



Courtesy of American Engineering Company

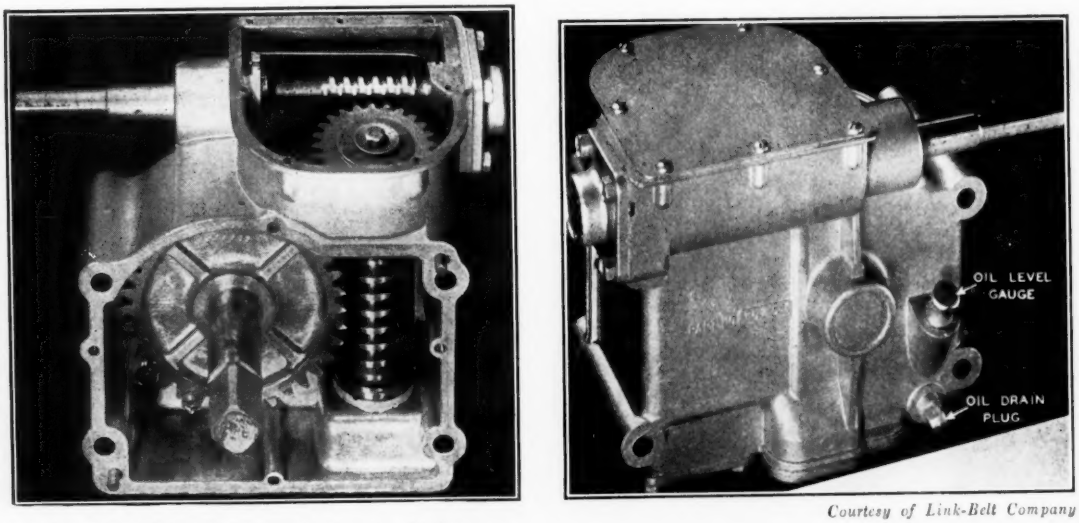
Fig. 9—Power box details of the Taylor stoker showing gear and bearing assembly.

Point of Lubricant Application

Steam cylinder oils should be introduced into the steam-line a few feet above or preceding the throttle valve wherever practicable. This will allow time for atomization to be completed by the time the lubricated steam reaches the throttle valve; this insures lubrication of this element along with the engine valves and cylinders.

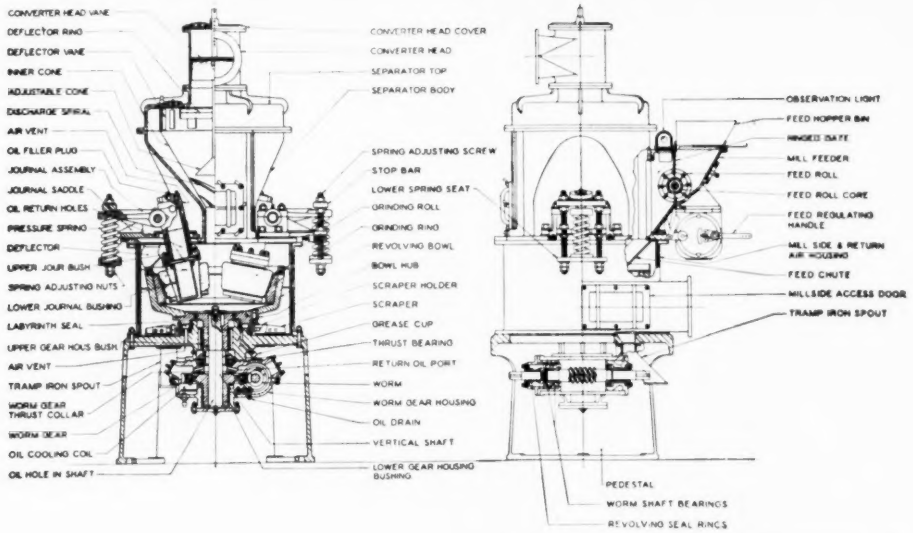
Where oil is introduced too close to the throttle valve or cylinder, complete atomization may not take place; if too far away there will

be a possibility of the oil particles being thrown out of the steam and onto the walls of the steam-line, to flow in liquid form to the valve chest. This condensation of lubricant may be quite considerable if there are any bends or other pipe fittings located between the lubricator and the valve chest. It is not conducive to effective lubrication.



Courtesy of Link-Belt Company

Fig. 10—The Link-Belt stoker speed reducer mechanism.



Courtesy of Combustion Engineering Company, Inc.

Fig. 11—Structural details of the Raymond pulverizer bowl mill. Features of the lubricating system are also shown.

Reduction Gears

Worm and spur gears are other important parts from the viewpoint of lubrication. According to the type of machine, where worm gear drives are involved, the worms may be located either above or below the main driving gears. As a result, their lubrication requires consideration from two angles.

Stokers especially will run normally at low speeds due to the gradual rate at which the coal must be fed. As a result, large speed reductions are used especially where the prime mover is a turbine or an electric motor. The selection of the lubricant for such a drive should be based primarily upon the type of gear casing installed. In other words, an oil-tight casing will permit bath lubrication and the use of a lubricant of just sufficient viscosity to preclude wearing of the teeth. Where but a

safety gear shield or an open or leaky case is involved, a heavier, more viscous type lubricant may be necessary.

Worm Gear Requirements

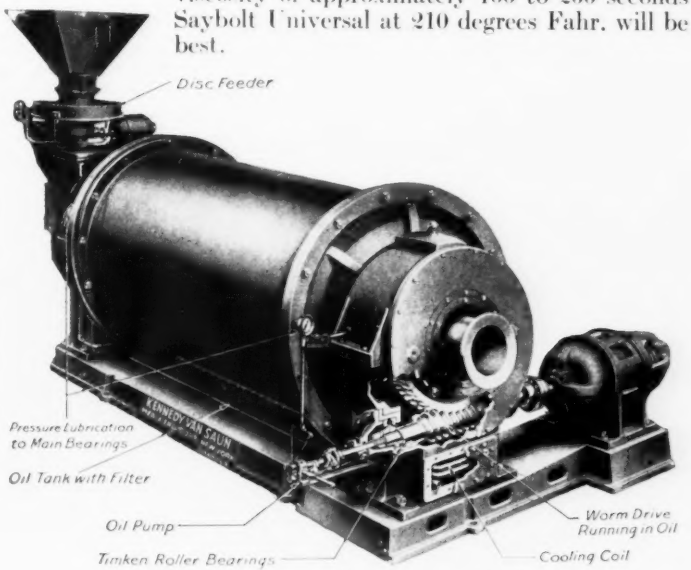
Worm gears require a comparatively high viscosity lubricant of sufficient adhesiveness to resist being wiped off the teeth when subjected to their combined sliding and rolling action. In many installations the same lubricant must not only serve to lubricate the gears but also the worm shaft thrust bearings. Inasmuch as the lubricating requirements will differ considerably, in such cases it will be necessary to compromise and use a lubricant as suitable to both as possible. Usually a steam cylinder oil of medium body and compound will function satisfactorily.

The location of the worm with respect to the gear is important not only from the viewpoint of selection of the grade of lubricant, but also as to the manner of lubrication. When the worm is located below the gear it should be submerged to approximately the center line of the worm shaft. This will insure the transference of sufficient lubricant to the gear teeth as they mesh with the worm.

This condition will not exist to the same extent, however, when the worm is above the gear, due to the lower surface area of the gear teeth, and the fact that the lubricant may tend to travel along the worm shaft and drip down outside the trough. Also, especially when the drive is first started up there may be possibility of an insufficient film of lubricant being carried by the gear teeth to the worm. Accordingly, it may be advisable to run the gears submerged in lubricant to the full depth of their lower teeth, using a highly adhesive, though relatively fluid product which will stick tenaciously to the tooth surfaces and not drip off even where radiated heat may be relatively high.

Spur and Bevel Gear Drives

Where pulverizers or stokers are equipped with spur or bevel gear drives, these latter will in general be adequately enclosed in a suitable housing or base reservoir which will enable the use of more fluid lubricants than sometimes used in a worm reduction gear installation. In some installations a straight mineral oil from 700 to 800 seconds Saybolt Universal viscosity at 100 degrees Fahr., will often suffice. In others, where higher pressure, vibration or slow speeds are involved, a heavier lubricant capable of adhering tenaciously to gear and pinion teeth should be used. Here an oil having a viscosity of approximately 100 to 200 seconds Saybolt Universal at 210 degrees Fahr. will be best.



Courtesy of Kennedy-Van Saun Manufacturing and Engineering Corporation

Fig. 12—Details of Kennedy worm driven air-swept tube mill showing lubrication features.

Exposed Gearings

When gear drives are not enclosed in an oil-tight casing, bath lubrication is usually precluded, and it becomes necessary to apply the lubricant by hand, in heated condition, by means of a brush. In such instances the lubricant must be of considerably higher viscosity than specified above since it must maintain a suitable film on the teeth for a considerable period of time.

Low viscosity oils or non-adhesive greases will drip off when thinned down under the higher temperatures encountered. For such gears it is, therefore, advisable to use a straight mineral gear lubricant of approximately 500 to 1000 seconds viscosity Saybolt Universal at 210 degrees Fahr. Dirt and dust must also be considered when lubricating reduction gears of this type. Therefore, frequent attention should be given to cleaning the entire mechanism, otherwise excessive wear may occur due to the presence of abrasive material in the lubricating film on the teeth.

Stoker Bearings

Bearings in a stoker installation are internal and external in location. Internal bearings

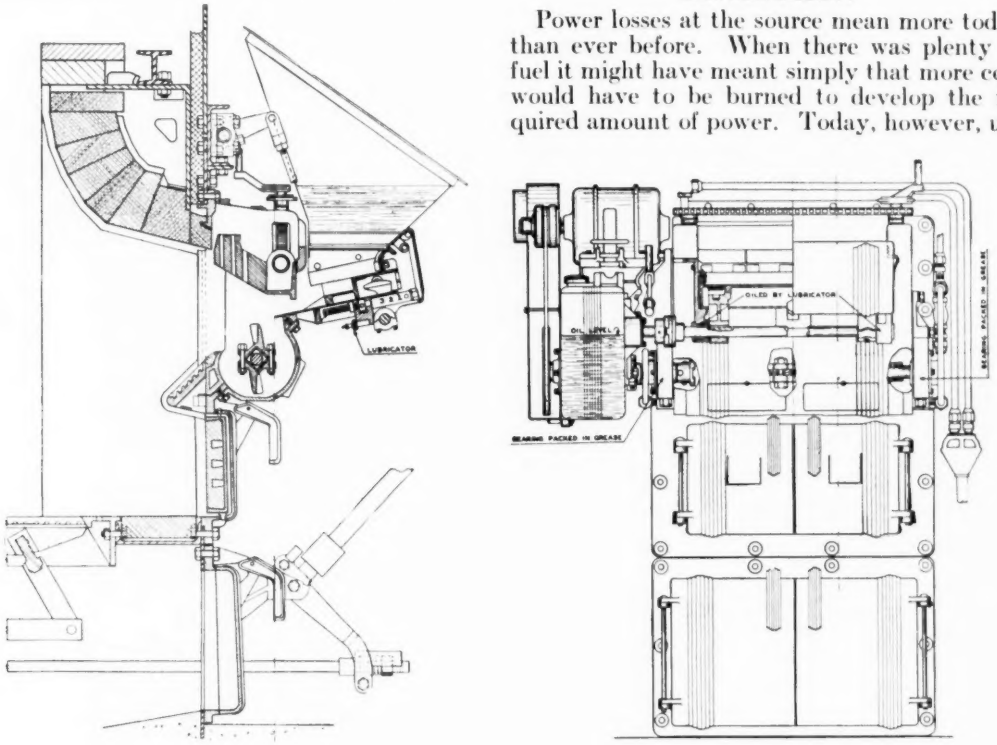
usually get little or no lubrication; in fact, they are generally built with fairly high clearances, to operate without oil. The amount of motion to which they are subject is relatively slight, as is also the comparative rubbing speed.

External bearings, however, should receive careful attention. Frequently they are designed for grease lubrication, being equipped with suitable grease cups, or fittings for pressure lubrication. These are usually dustproof and insure a supply of clean lubricant to the bearing surfaces. Grease also tends to work out toward the end of the bearing and prevent the entry of dust along the shaft. For such service a medium-bodied compression cup grease free from thickeners or non-lubricating adulterants will function satisfactorily.

It is also important to remember that in certain stokers the bearings of at least part of the gear shafting involved will be designed for lubrication by the same lubricant as serves the gears.

This simplifies the problem from a labor point of view; it also insures the bearings of more positive lubrication than where periodic attention is necessary. It necessitates, however, more careful selection of the lubricant, for the requirements of both gear teeth and bearings must be adequately met.

Where it is desirable to use the same oil for the external bearings of both the prime mover and the stoker, a medium viscosity engine oil of from 300 to 500 seconds viscosity Saybolt Universal at 100 degrees Fahr., will be suitable.



Courtesy of Wm. Bros Boiler & Manufacturing Company

Fig. 13—Assembly of a Bros stoker drive and control linkage showing features of lubrication.

CONCLUSION

Power losses at the source mean more today than ever before. When there was plenty of fuel it might have meant simply that more coal would have to be burned to develop the required amount of power. Today, however, unwarranted power losses may well lead to reduced production output—for every industrial plant must have power. If fuel is limited, and power is wasted, then production must suffer. Hence our interest in the lubrication of the machinery that delivers the fuel to the boilers—where power generation commences. When the stoker or coal pulverizer functions efficiently and it is properly lubricated, the plant is well on its way to maximum power output. The engineer who appreciates "the protective value of lubrication" appreciates those other niceties which result in a well operated plant.

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for
COAL PULVERIZING MACHINERY

MOTOR AND PULVERIZER BEARINGS

RING OILERS	
Normal Temperatures	Texaco Cetus or Alcaid Oil Texaco Canopus Oil or Texaco Nabob or Aleph Oil
Low Temperatures	Texaco Capella Oil or Texaco Cetus Oil
High Temperatures	Texaco Alcaid or Algol Oil, or Texaco Aleph or Altair Oil
BALL AND ROLLER BEARINGS *(Oil Lubricated)*	
Where Housings are Oil-tight, Operating Conditions Normal and Speeds High	Texaco Capella Oil B
For Roller Bearings Where End Thrust is Appreciable; and Ball Bearings Under Low Speeds and Higher Temperatures	Texaco Capella Oil D or E
For Roller Bearings Operating Under Extreme Temperature and Pressure	Texaco Ursa Oils
BALL AND ROLLER BEARINGS *(Grease Lubricated)*	
According to Type and Construction of the Bearing, and Operating Pressures and Temperatures	Texaco Starfak Grease No. 00, No. 2 or No. 3, or Texaco Marfak

GEARS AND CHAINS

SILENT CHAIN DRIVES	
Chains Submerged and Bath Lubricated	Texaco Altair Oil or Aries Oil
Chains Exposed, or Enclosed but not Running in Oil	Texaco Pinnacle Mineral Cylinder Oil Texaco Thuban 140 Texaco Crater No. 0
GEARS—SPUR, BEVEL OR WORM TYPE	
Enclosed in Oil-tight Cases *	Texaco 650 T Cylinder Oil Texaco Texol H or Texaco Thuban 140
Where Gears are Exposed, or not Tightly Housed (According to Temperature)	Texaco Crater No. 0 or No. 1

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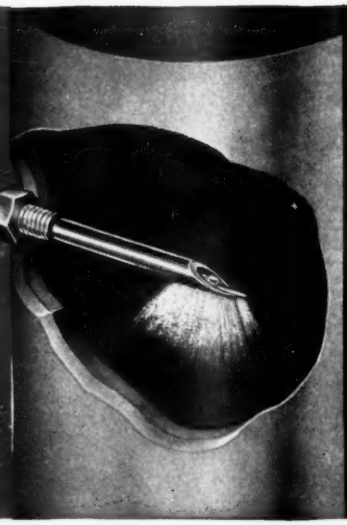
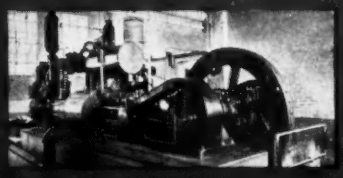
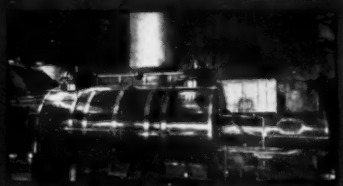
Cutaway view of Bowser terminal check valve and atomizer quill.







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